to be descended from two brothers, Darode and Tsak, Ogadayn was a son of the former.

The Lake Mœris.—Mr. Cope Whitehouse described to the British Association the basin of the Reian Mœris in Egypt, and spoke of the possibility of the restoration of this historic lake. South of the Fayoum exists a depression of several hundred square miles, not less than 150 feet below the Mediterranean, and in the parts visited by the writer, 175 to 180 feet deep. The area is irregular, curving like a horn from near Behnessa to the ridge which separates it from the Fayoum. Ruins exist in its southern part. The level of the ruins proved that the ancient station of Ptolemais might have been as shown in the text and maps of Ptolemy, on a horn-shaped lake about thirty-five miles long and fifteen wide.

The Kassai Tributary of the Congo.—Lieut. Wissman speaks enthusiastically of the Kassai as a magnificent fluvial artery, frequently of enormous breadth, leading into the heart of the new Congo State. The country on its banks is of wonderful fertility. During the forty-two days occupied in the voyage from Luluaburg to Kwamouth, the health of the expedition was excellent, the five whites and 200 negroes all arriving in good health at Leopoldville on July 16th. The Sankaru and Lubilash are one river, which turns westward, and joins the Kassai. The Kassai receives the great Kòango, and enters the main river by the Kwamouth, after receiving the waters of Lake Leopold.

African News.—The country between Blantyre and Quillimane has been described by Mr. H. E. O'Neill and Mr. D. J. Rankin in the Proceedings of the Royal Geographical Society. The Portuguese authority has recently been considerably extended up the Shiré towards Lake Nyassa.——The Kassai, the great southern tributary of the Congo, instead of entering the main stream north of the equator, joins it in 3° 13′ S. lat.——Mr. D. D. Veth, leader of a Dutch expedition into Portuguese West Africa, died on May 10th, between Benguela and Humpata.

GEOLOGY AND PALÆONTOLOGY.

INTERNAL CHEMICAL AND MECHANICAL EROSION A FACTOR IN CONTINENT AND MOUNTAIN BUILDING.—As soon as it is affirmed that since early Laurentian times the great continental folds and depressions have not changed places, so soon it becomes necessary to explain how these great ridges and troughs have persisted, as such, in spite of the amount of erosion and sedimentation which are known to have taken place and which we know to be still going on at no small rate. Either the pre-Laurentian inequalities of surface were vastly greater than they are now, or else, during all the ages the ocean beds have been constantly receiving sediment and sinking, while the continents have been as constantly eroded and rising. But this latter hypothesis implies

that there has been and is a continuous circulation of the material of the solid land from the continents to the ocean, and from the ocean back to the continents again, a circulation, in some degree, like what is taking place in the ocean between the equator and the poles, that is, a bodily transfer of superficial materials one way and a slow general under-creep of materials back.

But how is such a system possible and how can it be maintained? If we assume, as appears to be required by both physical principles and geological facts, that the earth's surface is only slightly out of equilibrium and is constantly tending toward that state, then any transfer of material from the continents to the ocean would cause a subsidence of the ocean beds which, in turn, must necessitate a setting of the deeper earth materials from beneath the ocean beds toward the continents causing them to rise. This circulation appears to be entirely possible and even probable, if not almost certain, and this too, while granting that the earth is essentially solid throughout and as rigid as glass. By this is meant, of course, as rigid as glass would be under the internal earth pressure.

It appears to me, geologists have no occasion for dissenting from the views expressed by leading physicists in regard to the rigidity of the earth for, as I see it, there may be all the rigidity which physicists have claimed and yet all the mobility geological facts can demand. When cold metals are subjected to artificial pressure, causing their molecules to flow into new positions so that the form of the mass is greatly changed, it is not to be supposed that these metals while under such pressure are to be regarded as true liquids, in any sense obedient to all the laws of fluids, nor could any mere pressure, however great, convert them into true liquids. I think it will not be maintained, even by those who believe "pressure itself would reduce the interior of the earth to a fluid condition," that this fluid is such to the extent of permitting bodies moving freely through it as fish move through the sea; nor would they maintain that this interior fluid would remain such with the pressure removed. It could hardly be maintained either, that such a fluid would possess the degree of elasticity characteristlc of true fluids, but unless these are insisted upon by geologists, physicists have all the rigidity they have claimed.

Even if it is admitted that such a circulation is possible when conditions are once favorable, unless there is some disturbing agent continually working to destroy the equilibrium which the circulation tends to establish, eventually the earth's surface must have existing differences of level greatly reduced. There appears no escape from the conclusion that the density of the earth increases as its center is approached. This being the case, a continual denudation from certain regions and constant sedimentation in others must, in due time, whatever may have been the original distribu-

tion of density near the earth's surface, remove all materials of low density from the continents and place them over the sea bottom, while the elevation of the denuded region would bring denser materials to the surface, thus tending to restore equilibrium with the two surfaces more nearly on the same level, unless there is some agent operating to reduce the average specific gravity of the continents.

If the earth does increase in density toward the center, this may be due: first, to a difference of chemical composition; or second, to increasing pressure; or third, to these two conditions in combination. With either the first or third conditions existing, and continued denudation with no counter agent, a leveling up would inevitably result. With the second condition existing, unloading in one place and loading in another of equal area, would permit of expansion in the continental mass and cause a compression of strata under the oceans, and might maintain the differences of level already established; but this view being very improbable, it remains to search for some cause which may reduce the specific gravity of the continents, and an adequate one, it seems to me, may be found in internal chemical and mechanical erosion.

Taking Mr. T. M. Read's estimate of chemical erosion (Am. Jour. Sci., April, 1885), at 100 tons per square mile annually on the average the world over, as a fair estimate of the work done by the waters which come to the surface before emptying into the ocean, it is plain that a vast work must be done in reducing the average specific gravity of the continents, unless it is maintained that the small cavities produced are closed by compression as fast as formed. This certainly is not the case in the superficial strata, nor can it be the case in the deeper strata where the cavities produced by solution remain filled with water.

Data are altogether too meager to allow of a quantitative treatment of the question. We do not know, for example, what proportion of the matter carried in solution to the sea by rivers annually is obtained through purely superficial action. Neither do we know what proportion of the water falling upon the continents enters the ocean below ocean level. It is reasonable to suppose that this amount is not small, and that the water entering the sea below ocean level carries a higher per cent of solids than the average river water. Now that our Government scientific work is being consolidated, it would seem eminently fitting that these fundamental questions should occupy the joint attention of the U. S. Geological Servey and the Signal Service, and they are possibly already under consideration.

This internal erosion, by excavating small cavities in the body of the continents, would lighten them without in the same degree lowering their surfaces, and existing differences of level would be longer, if not permanently, maintained, because in case the denser strata were to be thrust up into the heart of the continents, into the

region of aqueous action, they would be attacked by the water and their average specific gravity lowered. Now in case superficial erosion were to exceed internal erosion, the result would be a lowering of the continents; but any lowering of the continents would reduce the rate of mechanical erosion much faster than it would the chemical, because very feeble springs and the mere capillary updraught of saturated water, would remove the solid ingredients of the continents and place them in position to be drawn off to the sea by currents too feeble to bear much solid material in suspension. The specific gravity of the continents would, by this means, be continually lowered, and the oceanic areas as continuously loaded, and, for this reason, we might expect the continents and oceanic basins to persist. Again, even if we suppose the same degree of porosity to exist in the sedimentary beds under the ocean as exists in those of the continents and the materials of the two to have the same specific gravity, the same number of feet of sediment under the ocean would be heavier, volume for volume, than the land because, if for no other reason, the beds would be, in all probability, more fully saturated with water. Now Professor Ferrel has shown that the attraction of continental plateaus must be neglected in reducing both pendulum and barometric observations to sea level, and therefore they do not represent so much material added between a given station and the earth's center; that is, these earth masses, although possessing longer radii, are no heavier than equal sections in the ocean areas.

Assuming that the continents and ocean beds, with their superincumbent water, are essentially in equilibrium, and taking the average depth of the oceans as 15,000 feet and the average height of continents, above sea level, as 1000 feet, we could obtain a tolerably accurate estimate of the average specific gravity of the continents if we knew the average density of the rocks below the sea bottom, knowing, as we do, the specific gravity of 15,000 feet of superimposed matter. The specific gravity of the earth 400 miles below the surface is estimated at 4.0478 (U. S. Coast and Geodetic Survey, 1879), and our heaviest known rocks scarcely run above 3. From these considerations, and from what we know of the specific gravity of sedimentary rocks, we should not expect the sedimentary beds of the sea bottom to have a specific gravity much above 2.5. Assuming an average of 2.5 for the first 5000 feet below sea bottom and of 2.95 for the next 10,000 feet, then the average specific gravity of the continental mass required to exactly balance this would be 1.851, assuming, of course, that a surface of uniform density under both oceans and continents is reached at a depth of 30,000 feet below the sea level. Now considering the specific gravity to increase below 15,000 feet below sea bottom at the rate of .05 for every 10,000 feet downward, it would then be necessary to go to a depth of about thirteen miles below sea level to obtain an average density sufficiently large to

balance continental masses having an average specific gravity of 2.5. If the specific gravity does not increase downward as rapidly as the rate assumed, as we may infer from Mr. Pierce's table (U. S. Coast and Geodetic Survey, 1879, p. 200), then a still greater depth would be required to secure equilibrium. From these considerations it would appear that the superficial continental strata must have an average specific gravity much below 2.5 and, in order that this may be so, that much material must have been removed from within the mass.—*F. H. King, River Falls, Wis., May 12, 1885.*

GEOLOGICAL SURVEY OF BELGIUM.—In 1878 a commission was appointed to undertake a more exhaustive investigation of the geology of Belgium than that embodied in the map of Dumont. The topographical map serving as a basis consists of 369 sheets. Each important group of formations is entrusted to one or more specialists, who are each furnished with two assistants, and trace the system completely across the country. Every actual outcrop of rock is marked on the map, and where the rock is fossiliferous the fossils are noted. Special attention is given to soils and subsoils, and care taken to express on the map the agricultural character of the ground. It is believed that one-third of the entire work of the survey is now completed. By a novel system of broad washes of subdued tints, M. Dupont, the head of the survey and Director of the Royal Museum at Brussels, contrives to show the surface deposits, as well as the formations below, which are shown in deeper tints; while shaded lines of the proper color mark the margins of the stage. Professor Archibald Geikie expresses in *Nature* his conviction of the success of the new system of cartography.

THE BED OF THE OCEAN.—The Tuesday evening discourse during the late meeting of the British Association was delivered by Mr. J. Murray, F.R.S., of the *Challenger* expedition, who took for his subject the "Bed of the ocean, and some results of the expedition." In commencing his lecture, Mr. Murray traced the development of geographical knowledge from the crude conception of the ancients down to the extended knowledge of the nineteenth century. It was not easy, he said, to estimate the relative importance of the events of one's own time, yet, in all probability, the historians of the reign of Victoria would point to the recent discoveries in the great oceans as the most important events of the century with respect to the acquisition of natural knowledge—as among the most brilliant conquests of man in his struggle with nature; and doubtless they would be able to trace the effects of these discoveries on the literature and on the philosophic conceptions of our age. The last of the great outlines showing the surface features of our globe had been boldly sketched; the foundations of a more complete and scientific physiography of the earth's

surface had been firmly laid down. The lecturer then briefly described the chief surface features of the globe, the action of wind and water and ocean currents; referred to the temperature of the surface of the sea, and explained that the most important, as well as the most direct, effect of the unequal distribution of temperature over the surfaces of the oceans and continents was an unequal distribution of atmospheric pressure, varying more or less with season. He then proceeded: The advances during recent years in the knowledge of one form of life inhabiting the floor of the ocean surpassed those in any other department of oceanic investigation. Thousands of new organisms had been discovered in all seas and at all depths in the ocean, and either had been or were now being described by specialists in all quarters of the world. There did not seem to be any part of the ocean bed so deep, so dark, so still, or where the pressure was so great as to have effectually raised a barrier to the invasion of life in some of its many forms. Even in the greater depths all the great divisions of the animal kingdom were represented. As they descended into the deeper waters, and proceeded further seaward from the borders of the continents, species and the number of individuals became fewer and fewer, though they often presented archaic or embryonic characters, till a minimum was reached in the greatest depths furthest from continental land. Distance from continental land was, indeed, a much more important factor in the distribution of deep-sea animals than actual depth. If they neglected the Protozoa and compared the results of twelve of the *Challenger's* trawlings and dredgings in the central line of the Pacific, in depths greater than 2000 fathoms, on globigerina ooze, radiolarian ooze, and red clay, with twelve trawlings and dredgings taken under similar conditions and depths, but on the blue and green muds within 200 miles of the continents, they found that the central Pacific stations yielded ninety-two specimens of animals belonging to fifty-two species, all—with two doubtful exceptions—new to science, and among them thirteen new genera. On the other hand, the stations near the continents gave over 1000 specimens, belonging to 211 species, of which 145 were new species and sixty-six belonged to species previously known from shallower water. Although no new types of structure had been discovered in organisms from the deep sea, the peculiar modifications which animals had undergone to accommodate themselves to abysmal conditions were sufficiently interesting and remarkable. The eyes of some fish and crustaceans had become atrophied or had disappeared altogether, while in others they had become of exceedingly large size, or been so modified as to be scarcely recognizable as eyes. Fins and antennæ had become extraordinarily elongated, and at times appeared to simulate the alcyonarians of the deep sea. The higher Crustacea and some families of fish had very few and very large eggs in the deep-sea species, while their

shallow-water representatives had a very large number of very small eggs; showing apparently that the deep-sea species had relatively few enemies. Many deep-sea animals emitted, and some had special organs for the emission of phosphorescent light, which appeared to play a large *rôle* in the economy of deep-sea life. One of the most striking facts with respect to deep-sea animals was their very wide distribution, the same species being found in all the great ocean basins. After referring to examinations of coral atolls and barren reefs, Mr. Murray said the results of many lines of investigation seemed to show that in the abysmal regions they had the most permanent areas of the earth's surface, and he was a bold man who still argued that in Tertiary times there was a large area of continental land in the Pacific, that there was once a Lemuria in the Indian ocean, or a continental Atlantis in the Atlantic. It mattered little whether the opinions which he had given as to the bearing of some of the researches be correct or not. The great point was that there had been a vast addition to human knowledge, and it must be a matter of satisfaction that our own country had taken so large a share in these important investigations as to call forth the admiration of scientific men of all countries. In the matter of deep-sea investigation, neglecting mere details, we could say that successive governments during the past twenty years had, either from design or by accident, undertaken a work in the highest interests of the race, had carried it on in no mean or narrow spirit, and were likely to carry it to a termination in a manner worthy of a great, free and prosperous people.

GEOLOGICAL NEWS.—*General.*—The third International Congress of Geologists has just been held in Berlin, 255 members being present, the majority Germans. Italy sent eighteen, Austria sixteen, Great Britain eleven, France ten, and the United States nine representatives. The most important work of the congress is the preparation of a geological map of Europe. It is expected that next year proofs in color of many of the sheets will be ready. The unification of geological nomenclature does not appear likely to be realized, but the congress has agreed that the Archæan rocks shall be divided into sections according to their petrographical characters, without expressing any opinion as to their relative age.

Jurassic.—At the recent meeting of the French Association, M. Cotteau stated that the Jurassic strata of France have furnished 125 species of Echini, belonging to fifty genera, two only of which, Cidaris and Stomechinus, subsist at the present day. The shallow seas of the Jurassic epoch, full of islands and coral reefs were favorable to the development of Echini.——M. Loriol has published, in the *Paléontologie francaise*, descriptions of 209 crinoids found in France. Of these eighty-nine were new to science;

while the Echini were most abundant in the Bajocian stage of the Jurassic, the crinoids attained their maximum in the Oxfordian. After the Sequanian they suddenly diminish, and only one species occurs in the Portlandian.

Quaternary.—At Ternefine near Maseara (Algeria) teeth of two species of Elephas (*E. atlanticus* and *E. melitensis*) have been found, also *Rhinocerus mauritanicus*, a hippopotamus and *Camelus thomasi.* The last is of about the size of the dromedary, but differs in the shape of the palate and jugal bones. With these were found a horse rather larger than the zebra, some antelopes, an ox, and a single bone of a swine. Roughly-shaped hatchets of limestone or coarse sandstone show the presence of man, but no remains of the domestic dog and no bones marked by the teeth of Carnivores were found. The presence of a large number of the cotyloid cavities of the pelvis of the elephant seem to indicate that they were used as utensils, and the numerous canines and incisors of the hippopotamus found were probably employed as weapons.

MINERALOGY AND PETROGRAPHY.[1]

AMERICAN MINERALS.—*Quartz.*—Vom Rath describes[2] quite a number of complicated forms on the quartz crystals from Alexander and Burke counties, N. C. The former have already been mentioned in these notes.[3] Among the rare forms on the latter are $-\frac{11}{18}R\frac{11}{7}$, P_2 and a rough face to which the symbol oP may be referred.

Stephanite.—In the same article a stephanite crystal from Mexico, containing the new form $\frac{11}{6}\breve{P}\frac{11}{3}$ is described.

Alaskaite of König,[4] has been reëxamined by Th. Liweh, of Strassburg, who declares it to be tetrahedrite. He found it to crystallize in the hemihedral division of the regular system.

In the November number of the NATURALIST, fayalite was mentioned as having been found by Mr. J. P. Iddings in the lithophyses of the obsidian and rhyolite from the Yellowstone Park. About the same time C. A. Tenne,[5] of Berlin, found the same small black crystals in the lithophyses of obsidians from the Cerro de las Navajas, Mexico. They were measured and pronounced to be the same mineral which G. Rose, as early as 1827,[6] had declared to be olivine.

[1] Edited by W. S. BAYLEY, Johns Hopkins Univ., Baltimore, Md.

[2] Mineralogische Mittheilungen. Zeitschrift für Krystallographie, x, pp. 156 and 475.

[3] May, 1885.

[4] Ueber die alaskaite, ein neues Glied aus der Reihe der wismuthsulfosalze. Zeitschrift für Krystallographie, VI, p. 42.

[5] Zeitschrift der deutschen geol. Gesellschaft, 1885, p. 613.

[6] Annalen der Physik. u. Chemie, 1827, Bd. x, pp. 323–332.